MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2016 / 2017

TIC 2151 – THEORY OF COMPUTATION
TCS 3511 – THEORY OF COMPUTING

(All sections / Groups)

2 JUNE 2017
3:00 P.M. – 5:00 P.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages (including cover page) with 6 Questions only.

2. Attempt **ANY FIVE** questions. All questions carry equal marks and the distribution of the marks for each question is given.

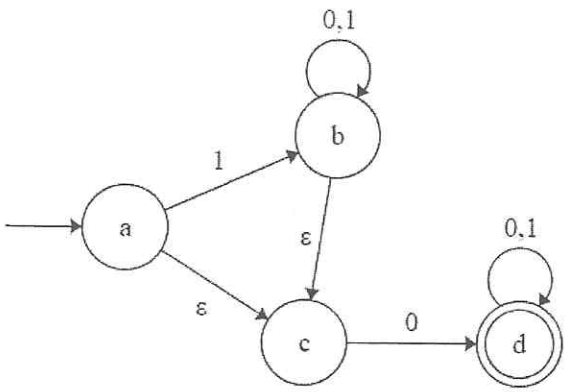
3. Please print all your answers in the Answer Booklet provided.

Question 1 (10 marks)

a) Describe TWO differences in the formal definitions of DFA and NFA.

[2 marks]

b) Write the ε–closure of each state in the following NFA:



[2 marks]

c) Draw the state diagram for a DFA that accepts the same language as the NFA in Question 1(b). Illustrate clearly the steps that is taken to create the DFA.

[6 marks]

Question 2 (10 marks)

a) Write a regular expression corresponding to the following language:

$$L1 = \{ w \in \{a, b\}^* \mid \text{w contains at least one a and at most one b} \}$$

[3 marks]

b) Draw an NFA that accepts the language given in Question 2(a).

[3 marks]

c) Give the regular grammar corresponding to the following language over the alphabet {0, 1}.

$$L2 = \{ w \mid \text{w does not begin and end with the same symbol} \}$$

[4 marks]

Continued ...

Question 3 (10 marks)

Consider the following context free grammar for Boolean expressions

E → E **or** E
E → E **and** E
E → (E)
E → **true**
E → **false**
E → **identifier**

a) Show that this grammar is ambiguous.

[4 marks]

b) Rewrite the grammar to remove the ambiguity.

[4 marks]

c) Show whether the following string is valid or invalid sentences in the grammar using derivation.

a or (b and c)

[2 marks]

Question 4 (10 marks)

Given the following language

$$L1 = \{ w \in \{a, b\}^* \mid w = a^n b^{2n}, n > 0 \}$$

a) Show that L1 is not a regular language.

[4 marks]

b) Construct a PDA for L1.

[4 marks]

c) Demonstrate whether the PDA will accept or reject the following w:

aabbbb

[2 marks]

Continued...

Question 5 (10 marks)

Given the following context free grammar:

$S \rightarrow \mathbf{aXb}$
$X \rightarrow \mathbf{a}Y \mid \varepsilon$
$Y \rightarrow X \mid \mathbf{c}$

a) Convert this grammar into Chomsky Normal Form (CNF). Show your main steps.

[4 marks]

b) Based on your answer in Question 5 (a), determine whether the following words can be derived from this grammar using the Cocke-Younger-Kasami (CYK) algorithm.

- **aacb**
- **aaac**

[6 marks]

Question 6 (10 marks)

(a) Give the formal definition, including the transition table, of a Turing machine for the following language:

$L4 = \{ w \mid w \in \{a, b\}^* \text{ and } w \text{ contains equal number of a's and b's } \}$

[6 marks]

(b) Briefly describe the halting problem and explain why it is an *undecidable* problem.

[4 marks]

End of Page